

1 1. A vaporizer for vaporizing a liquid and mixing the
2 vaporized liquid with a carrier gas, comprising:
3 a valve body defining a control valve cavity having
4 first, second and third apertures,
5 a gas inlet port connected to said first aperture
6 through a first fluid channel for receiving said carrier gas
7 at a given pressure,
8 a liquid inlet port connected to said second aperture
9 through a second fluid channel for receiving said liquid at
10 a flow rate and a pressure above said given pressure,
11 a closure element disposed adjacent to said second
12 aperture for forming a vaporization region having a pressure
13 gradient, said vaporization region circumscribing said liquid
14 inlet port and having a substantially larger width than said
15 inlet port, and
16 an outlet port connected to said third aperture
17 through a third fluid channel,
18 wherein liquid supplied through said liquid inlet port
19 vaporizes in said valve cavity to form a vaporized liquid,
20 mixes with said carrier gas, and is carried out of said
21 vaporizer through said outlet port.

1 2. The vaporizer of claim 1, wherein
2 said closure element is a diaphragm movable relative
3 to said second aperture to increase or decrease said flow rate
4 and further comprising
5 an actuator for moving said diaphragm toward and away
6 from said second aperture in response to a control signal.

1 3. The vaporizer of claim 2, further comprising
2 a liquid flow meter connected to measure the flow rate
3 of liquid into said liquid inlet port,
4 a feedback control system for providing said control
5 signal in response to a flow rate measured by said liquid flow
6 meter so as to regulate the flow rate of the liquid to
7 approximate a selected value.

1 4. The vaporizer of claim 2, wherein said actuator is
2 a piezoelectric member responsive to said control signal.

1 5. The vaporizer of claim 1 further comprising a
2 heater for heating at least a portion of said valve body near
3 to said cavity so as to inhibit said liquid from condensing
4 after it has vaporized.

1 6. The vaporizer of claim 2 further comprising a
2 heater for heating at least a portion of said valve body near
3 to said cavity so as to inhibit said liquid from condensing
4 after it has vaporized.

1 7. The vaporizer of claim 3 further comprising a
2 heater for heating at least a portion of said valve body near
3 to said cavity so as to inhibit said liquid from condensing
4 after it has vaporized.

1 8. A chemical vapor deposition system using a liquid
2 reactant and a carrier gas, comprising:

3 a chemical vapor deposition chamber having a gas inlet
4 port, and

5 a liquid reactant vaporizer having an outlet port
6 connected to said chamber inlet port, said vaporizer
7 comprising:

8 a valve body defining a control valve cavity
9 having first, second and third apertures, said outlet
10 port connected to said third aperture through a first
11 fluid channel,

12 a gas inlet port connected to said first aperture
13 through a second fluid channel for receiving said
14 carrier gas at a given pressure,

15 a liquid inlet port connected to said second
16 aperture through a third fluid channel for receiving
17 said liquid reactant at a flow rate and a pressure
18 above said given pressure,

19 a diaphragm disposed adjacent to said second
20 aperture for forming a vaporization region having a
21 pressure gradient, said vaporization region
22 circumscribing said liquid inlet port and having a
23 substantially larger width than said inlet port, and

24 wherein liquid reactant supplied through said
25 liquid inlet port vaporizes in said valve cavity to
26 form a vaporized reactant, mixes with said carrier
27 gas, and is carried out of said vaporizer through said
28 outlet port.

1 9. The chemical vapor deposition system of claim 6,
2 wherein said diaphragm is movable relative to said second
3 aperture, and further comprising

4 an actuator for moving said diaphragm toward and away
5 from said second aperture in response to a control signal,

6 a liquid mass flow monitor coupling said liquid
7 reactant to said liquid inlet port for measuring a mass flow
8 rate of said liquid reactant and generating an electrical mass
9 flow signal indicating said mass flow rate, and

10 electrical control means for comparing said mass flow
11 signal to a set point, for signalling said actuator to move
12 said diaphragm toward said second aperture when said mass flow
13 signal indicates a flow rate above said set point, and for
14 exciting said actuator to move said diaphragm away from said
15 second aperture when said mass flow signal indicates a flow
16 rate below said set point.